B. FISH SCREENING AND PASSAGE

FISH SCREENING AND FISH PASSAGE ANALYSIS

of the

CALFED BAY-DELTA PROGRAM
PHASE II DELTA CONVEYANCE ALTERNATIVES

Committee Status Report of the

CALFED Interagency Fish Facilities Technical Team
(Representing DWR, DFG, USBR, NMFS, USFWS, USGS & USEPA)

Prepared under the Direction of

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July 28, 1997

INTRODUCTION

An interagency Fish Facilities Technical Team composed of multidisciplinary agency fish passage experts and an independent advisory panel was assembled to investigate the major fish passage facility issues and alternatives within the CALFED Bay-Delta program. In addition, the Team assisted in the development of viable conceptual fish facilities and examined the feasibility and impacts of proposed fish facilities to be incorporated in the Bay-Delta solution.

The Team was assembled in May 1996 and jointly chaired by Dan Odenweller (DFG) and Darryl Hayes (DWR). The agency and consulting staff (Team members) involved in each of the approximately quarterly workshops is presented in Appendix A. Three outside fish facility experts were selected by the co-chairs and approved by the larger Team to provide balance and expertise on the facility alternatives and recommendations. The advisory panel included Ken Bates (Washington Department of Fisheries and Wildlife), Dennis Dorratcague (Montgomery-Watson Engineers), and Ned Taft (Alden Research Lab).

In addition to the organization and charge of the larger Fish Facility Team meetings, a smaller group was convened in spring 1997 to establish better communications between CALFED staff and a subgroup of the Fish Facilities Team. This smaller group dealt with the detail facilities and planning developments specific to the 17 alternatives being considered in Phase II of the CALFED Program, while the larger group was charged with determining the technical feasibility of screening at two general areas (i.e. north and south Delta). This group met on three occasions during April and May 1997 and was effective in helping CALFED and the Technical Team communicate with each other on the issues and needs. The Co-Chairs of the Fish Facility Team used this information and those of the Team to prepare an evaluation of the alternatives for CALFED consideration. Although the views on the specific alternatives have tried to incorporate the general recommendations of the Team on the north and south Delta fish facilities, these views remain those of the authors since they were not adequately reviewed by the Team. This review is included in Appendix B.

Several informational documents, "white papers", management questions, modeling results and presentations were prepared for each of the workshops. These documents as well as material prepared for previous evaluations of Delta alternative facilities (such as the "Peripheral Canal," the "North and South Delta Program," and the "Five Agency Salmon Team" evaluations) were used in building a foundation for a set of recommendations to CALFED on Fish Facilities planning. However, Team requests for more specific information on the CALFED alternatives, including proposed operations, and fishery protection goals were unanswered since CALFED had not advanced sufficiently to provide this detail. As a result, the team proceeded without the benefit of this information. These requests are restated as "Information Needs" in this report. Some of the referenced material includes the following:

- "Fish Facility Development Plan for the CALFED Bay/Delta Solutions Process (or "Where do we go from here"), dated July 22, 1996 by Darryl Hayes. This paper presented a series of questions in an attempt to focus the participants on the process, and the information needs.

- "Fish Facility Planning Considerations", dated October 1996 by Dan Odenweller. This brief discussion paper of fish facilities planning considerations included a list of questions to be answered by the appropriate CALFED working groups.

- "CALFED Fish Screening Assignment, Basis for Design Assumptions", dated November 15, 1996 by Dan Odenweller. This document describes a Team assignment to develop fish screens for a total of 15,000 cfs, in some combination from the north and south Delta.

- "Evaluation Of The Feasibility Of Protecting Downstream Migrant Chinook Salmon Smolts In The Sacramento River And San Joaquin River with Physical Facilities," dated July 15, 1991, by the Five Agency Salmon Team.

- Various workshop handout material on fish screening issues, hydraulic modeling of site specific designs, design criteria and meeting notes, dated December 1996 through May 1997 by Darryl Hayes and others.

After the Team reviewed and discussed the fish facility issues and design concepts being considered, a set of Team consensus recommendations was developed and is provided here. This document was thoroughly reviewed by the Team and can be used to assist CALFED in further developing and narrowing the alternatives from their perspective. Written responses from several of the Team members are included as Appendix C.

The conceptual design of the proposed fish passage facilities (juvenile and adult) relied on the vast experiences of the fish facility experts and investigations into several state-of-the-art fish facilities. Some of the projects these concepts were based on included the proposed Glenn-Colusa Irrigation District Screen (3000 cfs), the Tehema-Colusa Canal diversion (3,000 cfs), the Red Bluff Research Pumping Plant, the Tracy Fish Facility Investigations and several new fish screens in the Northwest. Conceptual renderings of proposed north and south Delta fish facilities are shown on Figures 1 and 2.

Although the Team considered several screening concepts and focused many of it's recommendations on one particular design (the off-channel multiple bay design with fish bypasses), it is important to understand that there are other factors that may influence this option and the reasons behind that choice. Until further development of the alternatives and flow criteria are established, several concepts, such as "In-River" screens at multiple diversion points, or new applications of new technologies may be reconsidered. These options generally have site specific limitations, flow requirements, operational concerns or will require long lead times to develop the necessary biological or hydraulic criteria. Therefore, the Team decided to focus on a concept that we all believed would be the most flexible and adaptive as well as not going too far beyond our current understanding and screening criteria developed for larger fish screen structures. This approach helped us focus on the question of feasibility, research needs and significant issues which was our charge.

The Team will continue to meet on an approximately quarterly basis, or as necessary, as the CALFED Bay-Delta Alternatives are refined. With new information, the Team will review and investigate refined concepts, determine construction sequencing or phasing options, develop specific testing or focused research programs, perform hydraulic and operational models, and report findings to CALFED.

Fish Facility Team Recommendations for the CALFED Phase II Alternatives

June 2, 1997

GENERAL

Note: No screening facility has been or can be constructed and operated without some negative impacts. This will also be true of all proposed facilities, especially considering their scale and inclusion of elements that have limited track records (e.g. "fish friendly" pumps). In general, the greater the flow diverted the greater the impact. These impacts are due to the screening and bypass process itself and are in addition to the impacts of removing water from a river system.

1) Based on the Fish Facilities Team Analysis and their collective professional judgement, there are no technical limitations of constructing fish protection facilities for anything up to 15,000 cfs diversion capacities. However, a size of about 3,000 cfs is the largest screening example in existence. Therefore, breaking the facility into a series of smaller screens (multiple bay units of say 3,000 cfs) is preferable. In addition, there are hydraulic and fish exposure issues that are addressed by this size of unit.

2) Facility operation and function should be made with the understanding that the entire context of flow schedules, storage, and fish and ecosystem needs are balanced. Any alternative should be fully integrated hydrodynamically and operationally through rigorous modeling of all components together in the context of Delta hydrodynamic issues. These studies may dramatically effect fish migration and fish facility operations. Facility design may be modified when further information is available.

3) The use of "best feasible technology" should be recommended for all diversion screening locations. Presently, for screen systems we have focused on vertical flat plate screens which meet agency criteria, however, we do not intend to limit the development or application of new technologies or configurations if they are adequately developed prior to final design. Fish screen design criteria shall apply uniformly at the North and South Delta facilities (i.e. new facilities should use positive barrier screens).

4) Fish screens will be designed to protect fish in the vicinity of the screen over one inch in length....not eggs and larvae.

5) It is desirable to keep as many fish in the river from which they came so they may continue their residence or migration.

6) It may be desirable to divert a portion of the Sacramento River and a portion of the San Joaquin River to minimize the fish impacts on both rivers.

7) It is desirable to provide diversion flexibility in the system to adjust diversions between intakes (north and south Delta) to take advantage of river flows and react to specific events like eggs and larvae and hatchery releases. However, to accommodate ultimate flexibility, full sized facilities (i.e. assuming available flow) would potentially have to be built at each intake site requiring more operational assurances and complexity.

8) Facilities which minimize fish bypass handling and decrease potential delays in downstream fish migration are preferable to facilities and alternatives that do not.

NORTH DELTA DIVERSION SCREENS (Isolated or Through Delta)

9) Diversion screens should be located as far upstream as practical, given site suitability and construction feasibility, to minimize the impacts related to the tidal influence, resident Delta fish species (such as locating the diversion further away from delta smelt habitat which we have less certainty of protecting with a screen), water quality, fish salvage, and debris handling.

10) We recommend a North Delta isolated diversion at 15,000 cfs over all other North Delta conveyance options (primarily based on fish facility performance). The Team agreed that it made little sense to screen at Hood and then expose the concentrated fish left in the river to an unscreened diversion at the Delta Cross Channel (or allow unscreened cross Delta flows). Therefore, the Team felt that the DCC gates should be closed most of the year as they are now.

11) To avoid potential impacts to upstream migrating fish (salmonids, Striped bass, sturgeon, longfin smelt, etc.), an isolated facility is preferable to a screened through Delta conveyance option. Impacts may include delays, passage blockage, straying, and temperature related stresses.

12) If "through-Delta" fish screen facilities are considered, they must deal with passing a variety of fish which may be falsely attracted to the back side of the fish screen. A variety of options are necessary including fish lifts, false weir ladders and periodic screen openings. The performance of these facilities, however, is largely unknown for many Delta fish species.

13) Positive barrier screens should be located off-channel in multiple bayed, Vee configured arrangements to operate with uniform hydraulic conditions under all possible river and diversion conditions. Gates to isolate individual screen bays should be provided for hydraulic performance, operational flexibility, and maintenance. Wedgewire screens (with adjustable baffles) will be used.

14) Physical model studies (in addition to numerical model studies) should be used to assist in designing a major fish facility and evaluate site hydraulic conditions.

15) Numerical Model runs indicate that an acceptable velocity and flow distribution can be achieved at the screens at diversions ranging from 2,000 to 15,000 cfs, even at extreme river flow conditions.

16) Clean screens are essential to function. Surface deflectors, trash racks with automated debris removal systems and screen brush cleaners or comparable devices are necessary.

17) Sediment removal basins and resuspension systems should be considered for all facilities.

18) On-river screening concepts should be considered for concentrated diversions of 5000 cfs or less, or where hydraulic conditions or maintenance considerations would be favorable to their development.

19) A low head canal pumping plant behind the fish screened diversion is essential for the controlled hydraulic performance of the screen and bypass system.

20) Fish screen bypasses with "fish friendly" water pumps/lifts will be required. Such pumps are experimental, but the preferred alternative. Fish pumps/lifts will be required to induce bypass flow and overcome differential head in return pipes. The committee feels that the fish passage effectiveness of appropriately sized pumps is a reasonable expectation based on tests being conducted at Red Bluff with large pumps (e.g. internal helical) and lifts (e.g. Archimedes).

21) The fish bypass should be a closed pipe (as opposed to an open channel) and about three to five percent of the total diverted flow. The bypass will exit fish in the center of the main river channel at near invert depth. The bypass pump/return system design will have to balance pump head, velocity, passage, and predation issues.

22) The team concurs that the diversion must be designed and operated such that a particle released from the bypass will not recirculate into the diversion intake channel. The maximum bypass length should not exceed 5000 feet.

23) Additional storage capacity south of the Delta and "in-canal", can be considered

to help balance water requirements with water withdrawal rates in consideration of fish protection needs. Added storage would permit withdrawals to be curtailed or ceased during critical fish passage periods. For example, the ~40 miles of canal created by an isolated conveyance would represent additional storage in itself.

SOUTH DELTA SCREEN FACILITIES

24) Added complexities of species, temperature, fish hauling, and debris conditions in the South Delta will increase the cost and risk of any facility at that site.

25) We are not in favor of this alternative as a stand alone source for pumped water because it would draw Sacramento River water across the Delta leaving us with much the same problem that we now have (given existing aquatic habitat and hydrodynamic conditions in the Delta).

26) The requirement of a south Delta facility to collect, sort, hold and truck fish was viewed by the Team as a major disadvantage (viewed as a fatal flaw by some) of this alternative. A facility here would be best used as a backup facility to a north Delta diversion facility or used for occasional system operational flexibility.

27) Debris is a major problem with the existing louver facilities. Debris loading is increasing as new aquatic plants increase in diversity and abundance. Any new facility will have to include effective debris management systems.

28) The facility type shall be of the same type as considered in the North, except that additional provisions for debris and extreme flow variables be incorporated (See #33 and 34). Due to shallow channels, the screen invert would be higher and the screen length longer. This would require more bays (to reduce fish screen exposure in any given bay) and higher capital costs.

29) A multiple bayed, positive barrier Vèe screen should be constructed in an off-channel configuration much like that proposed for the north Delta. Each bay shall have automatic flow control structures and gates to control the hydraulics from the dynamic tidal filling of the Clifton Court Forebay.

30) The screens will likely have to be sized 50 to 100 percent larger (when placed at the CCF intake site) than the pumping capacity to overcome CCF inflow (even if control gates are installed). An isolated conveyance facility putting water in CCF could reduce the SD screen sizing requirement (unless more intake flexibility is desirable).

31) Fish shall be collected at the bypasses and transported back to the Delta away from the hydraulic influences of the pumps with in-river considerations for

predation, temperature, water quality, diel, tidal and lighting issues. Fish holding facilities shall not be designed like the existing system due to the problems with debris, hydraulic head, predation, etc. Fish sorting may be considered as well as "fish friendly" lifts, debris separators, and alternative fish transport methods (barging?).

32) There are at least water quality and possibly fish or other ecosystem benefits for maintaining some level of pumping facilities in the South Delta. We suggest that, as a strawman, something like a third of the total export capacity be provided with best technology fish protection in the South Delta. Larger facilities may be constructed for added flexibility, but this comes with added cost and requires more assurances for proper operation.

33) Any new fish facilities contemplated for CCF should be placed at the intake to minimize predation. Although there was not a specific disagreement amongst the Team, there was not a consensus that a screen that could supply the full capacity of the SWP and CVP diversion inflows could be built in the CCF or the surrounding South Delta.

34) The function of CCF will still be necessary to prevent cavitation at the pumps and to stabilize water levels in the south Delta. CCF may be required to be enlarged to meet the demands of both the CVP and SWP if there is an intertie.

35) The existing Tracy louver facilities require major capital improvements merely to keep them operational for the next 10-15 years. Our Team recommended a replacement facility there using best feasible technology positive barrier screens. This facility could be used as a pilot facility for expanded facilities and even be a part of future screen facilities in the South Delta. However, upgrading the Tracy Fish Facility should be done within an overall, long-term solution package that has been committed to. Improving these facilities for the interim, on a parallel track, provides an incremental benefit, but it should not serve to pre-select a solution that would not otherwise be chosen or delay a comprehensive solution. The latter would clearly be to the detriment of the resource.

APPENDIX A

CALFED Interagency Fish Facility Technical Team (Large Team) Workshop/Meeting Participants

Phase II - Meeting 1, December 12, 1996

Attendance List:

Darryl Hayes (co-chair), DWR ESO
Dan Odenweller (co-chair), DFG IFD
Jeanne Schallberger, DWR DOE
Ted Frink, DWR ESO
Shawn Mayr, DWR ESO
Marcin Whitman, NMFS
Michael Thabault, USFWS
Brent Mefford, USBR Denver Technical Center
Charles Liston, USBR Denver Environmental Sciences
Ron Brockman, USBR
Michael Lee, USBR
George Heise, DFG ESD
Kevan Urquhart, DFG Bay-Delta
Bob Fugimura, DFG Bay-Delta
Scott Barrow, DFG Bay-Delta
George Edwards, DFG Bay-Delta
Ron Ott, CALFED
Michelle Wong, CALFED
Jim Buell, Buell and Associates and Metropolitan Water District
Dennis Dorratcague, Montgomery-Watson and CALFED Consultant
Ned Taft, Alden Research Lab and DWR Consultant
Ken Bates, Washington Department of Fisheries and Wildlife and DWR Consultant

Phase II - Meeting 2, February 25, 1997

Attendance List:

Darryl Hayes (co-chair), DWR ESO
Dan Odenweller (co-chair), DFG IFD
Randall Brown, DWR
Jeanne Schallberger, DWR DOE
Ted Frink, DWR ESO

(Phase II - Meeting 2, February 25, 1997)
(Attendance List continued from last page)

Marcin Whitman, NMFS
Brent Mefford, USBR Denver Technical Center
Ron Brockman, USBR
Michael Lee, USBR
George Heise, DFG ESD
Kevan Urquhart, DFG Bay-Delta
Bob Fujimura, DFG Bay-Delta
Scott Barrow, DFG Bay-Delta
George Edwards. DFG Bay-Delta
Jim Buell, Buell and Associates and Metropolitan Water District
Dennis Dorratcague, Montgomery-Watson and CALFED Consultant
Ned Taft, Alden Research Lab and DWR Consultant
Ken Bates, Washington Department of Fisheries and Wildlife and DWR Consultant
Dave Starks, DWR Delta Field Division
Jim Spence, DWR Operations and Maintenance

Phase II - Meeting 3, May 1, 1997

Attendance List:

Darryl Hayes (co-chair), DWR ESO
Dan Odenweller (co-chair), DFG IFD
Ron Ott, CALFED (PM only)
Ted Frink, DWR ESO
Marcin Whitman, NMFS
Brent Mefford, USBR Denver Technical Center
Ron Brockman, USBR
Dave Gore, USBR
George Heise, DFG ESD
Bob Fujimura, DFG Bay-Delta
Scott Barrow, DFG Bay-Delta
Jim Buell, Buell and Associates and Metropolitan Water District
Dennis Dorratcague, Montgomery-Watson and CALFED Consultant
Ken Bates, Washington Department of Fisheries and Wildlife and DWR Consultant
Jim Spence, DWR Operations and Maintenance

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CALFED Interagency Fish Facility Technical Team
Coordination Meeting (Small Team)
Meeting Participants

Phase II - Coordination Meeting 1, March 27, 1997

Attendance List:

Stein Buer, CALFED
Ron Ott CALFED
Darryl Hayes, DWR ESO
Ted Sommer, DWR ESO
Rick Oltman, USGS
Pete Chadwick, DFG
Bruce Herbold EPA
Michael Thabault, USFWS
Don Stevens, DFG B-D
Dan Odenweller, DFG IFD

Phase II - Coordination Meeting 2, April 30, 1997

Attendance List:

Darryl Hayes, DWR
Steve Yaeger, CALFED
Bellory Fong, CALFED
Kevan Urquhart, DFG B-D
Stein Buer, CALFED
Ron Ott CALFED
Pete Chadwick, DFG
Bruce Herbold EPA
Michael Thabault, USFWS
Dan Odenweller, DFG IFD
Jim Buell, Buell and Associates

Phase II - Coordination Meeting 3, May 9, 1997

Attendance List:

Stein Buer, CALFED
Ron Ott CALFED
Bellory Fong CALFED
Pete Chadwick, DFG
Bruce Herbold EPA
Darryl Hayes, DWR
Dan Odenweller, DFG IFD
Kevan Urquhart, DFG B-D
Jim Buell, Buell and Associates

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